

some thirty years carrying on a business enterprise that became probably the best of its kind in the country, that he developed one of the finest amateur herbaria in America, that he gave much thought and untold hours to the aid of botany, helping to found and conduct the New England Botanical Club, notably assisting its journal and generously aiding in important ways the Gray Herbarium, and that finally in his elderly years he prepared an illuminating contribution to the literature of travel,—truly an impressive aggregate of accomplishment.

Regarding the subjective side of his life, we may confidently infer that it was a very happy one. Beyond the ability of most human beings he found the world “full of a number of things”—of things charming to hear, delightful to see, delicious to eat, of things fascinating to study and to collect, of friends to cheer and of enterprises to aid. Never seeming to hurry, always ready for sociability, he filled his life with an amazing richness of diverse interests, each skillfully pursued to results of value.

THE FORMATION OF PEAT RIDGES ON THE SHORES OF MUSKEG LAKES IN NORTHERN ALBERTA¹

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THE shores of certain lakes in the central part of the Mackenzie River basin show series of peat ridges parallel to the water's edge. They have been observed and studied by the writer in the basin of Moose Lake (“Eight Lake” on the most recent maps²), approximately in latitude $59^{\circ} 35'$, longitude 113° . The lakes on which they were seen are shallow and have very gently sloping, marshy shores. Some have only one ridge, one to two feet high, while others show several, of similar height, extending at intervals back from the water. These do not occur continuously, but in broken lines, more accentuated in some places than in others.

The diagrams, FIG. 1, and the photograph, FIG. 2, show the general arrangement of the vegetation on the shores. The primary species are noted, and the details will be only summarized here. The associations of emergent aquatics are of four or five kinds. The ones inhab-

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² Dept. of the Interior of Canada, Topographical Surv., National Topographic Series, Sheet No. 84 P. (Peace Point) July, 1929.

iting the deeper water, dominated by *Potamogeton praelongus* and *Nymphozanthus variegatus* (*Nymphaea variegata*), are either nearly pure stands of these species, extended over wide zones, or contain only a few secondary species which are not conspicuous. The growth is not a dense one, being easily penetrated with boats. The only approach to a denser growth in the deeper water occurs with the insertion of the fifth type on some very shallow and protected shores. Here *Fluminea festucacea* and *Carex trichocarpa* var. *aristata* make close, nearly pure stands.

In shallower water, about one and one-half feet deep, and always a few yards off-shore, there is a comparatively narrow association of which *Scirpus validus* is dominant, making a thick, nearly impenetrable stand. There are frequent openings in this zone, so that it is not continuous along the shore. It is characterized by a larger number of secondary species than is shown by the associations described above: *Utricularia vulgaris*, *U. minor*, *Potamogeton Richardsonii*, *P. zosterifolius*, *P. Friesii*, *P. pusillus*, *Myriophyllum exalbescens*, *Sparganium* sp. (floating seedling), a floating moss, *Hypnum* sp., and an abundant plankton. The bottom is of decaying vegetation, through which it is possible to thrust a stick to a depth of about one and one-half feet to a solid substratum.

The shallow area between the *Scirpus* and the actual shore line is comparatively open water. Patches of *Myriophyllum exalbescens* make the commonest vegetation. Where a peat ridge rises abruptly at the edge of the water it has a plant cover dominated by *Salix planifolia*, *S. myrtillifolia*, and *Calamagrostis inexpansa*. Otherwise there is usually a *Typha latifolia* association of very dense growth followed by one in which *Carex diandra* is the most important species. The latter zone is very wet, having considerable standing water between the sedge tussocks. Farther back from the shore line there is drier ground, and colonizing *Calamagrostis inexpansa*, *Salix planifolia*, and *S. myrtillifolia*, with an association which, under normal conditions, passes to a *Picea canadensis* forest on still higher ground.

Where shore drainage is less complete, a *Picea mariana*-*Ledum groenlandicum* muskeg is developed instead of the *Picea canadensis* forest. Peat ridges observed on these shores develop a mixed type of vegetation, as shown in FIG. 1. *Salix myrtillifolia*, *Picea mariana*, *Larix laricina*, and *Calamagrostis inexpansa* are the primary species. The ridges, whatever their vegetation, are separated from each other

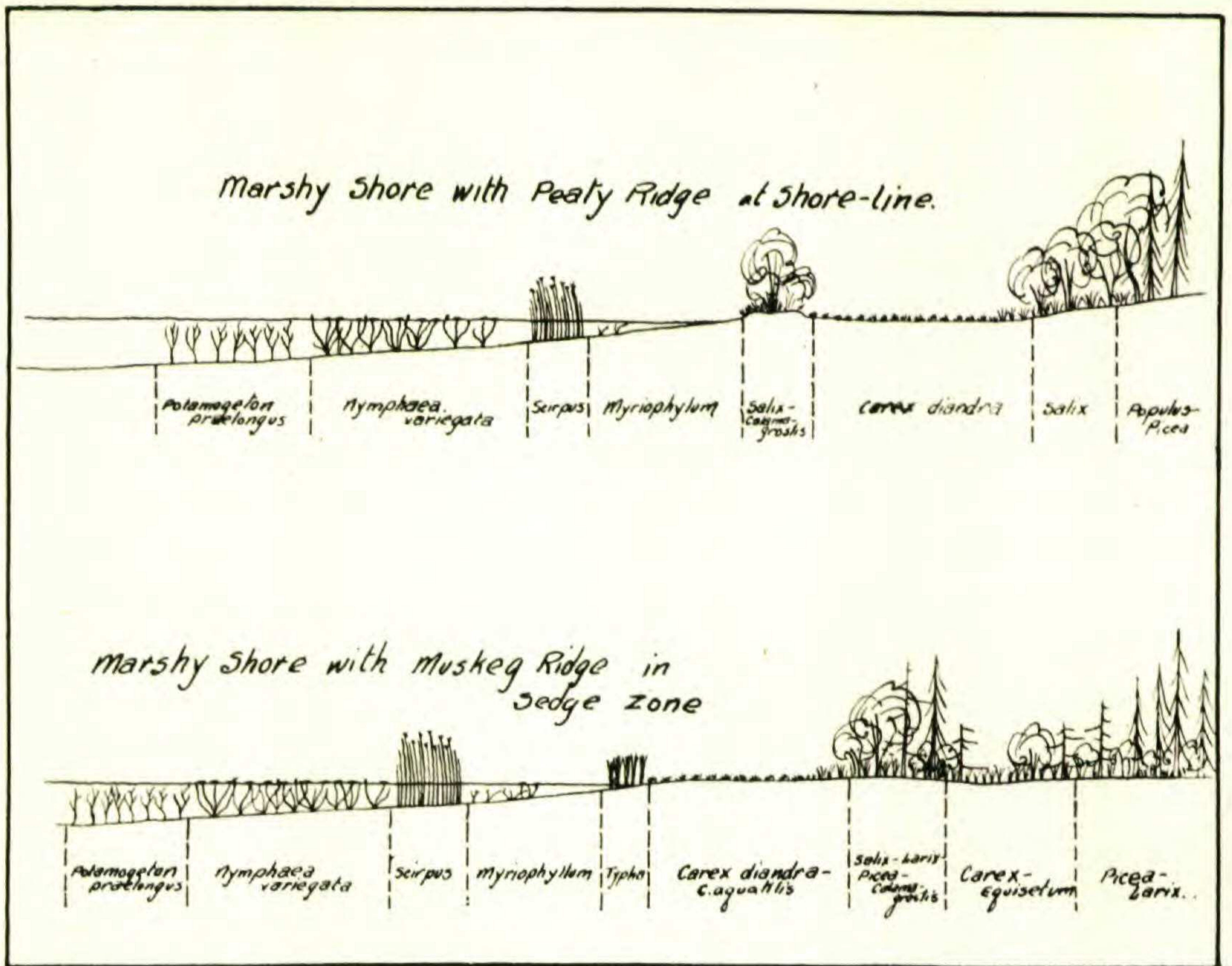


FIG. 1. Sections of the vegetation and peat ridge formations on the shore of Moose Lake, Aug. 1929.



FIG. 2. Aerial photograph of Seven Lake, showing the zonation of the vegetation on its shores. (Reproduced through the courtesy of the Director of Civil Aviation, Department of National Defense, Ottawa, Canada.)

or from more mesophytic associations by marshy, sedge or *Equisetum* zones.

From the above brief discussion it is evident that there are only two places in the shore zonation where there are particularly abundant sources of peat. These are in the *Scirpus* and *Typha* associations, where there is either a very dense growth of the primary species, alone or with an abundant stand of secondary species. It should be noted that these associations are in comparatively narrow, roughly parallel, discontinuous lines, separated by shallow water containing a scant vegetation.

During the retreat of the Pleistocene ice from the Athabasca-Great Slave Lake basin, a series of lakes, dammed by the ice front, formed in the major river valleys.¹ When the water stood at about the 1100-foot level the Moose Lake basin was entirely beneath the surface, and terminal moraines were forming at the ice front to the east. With the further retreat of the ice, and the opening of the lower Mackenzie drainage, the water was lowered to about the 800-foot level. The terminal moraines above mentioned, with others of the same age or older lying south of Moose Lake, appear to have held back a part of the former lake in the depression now occupied by Moose and Bog Lakes and many other unnamed bodies of water. The western boundary of this lake was on the eastern slope of the Caribou Mountains, while its northern extent is not ascertained. How long it lasted cannot be measured with present knowledge, but its age as a large lake was determined by the length of time required by its main drainage streams, the Little Buffalo and Jackfish Rivers, flowing to Great Slave Lake and Peace River, respectively, to cut through the morainic barriers that dammed them.

That this process of the lowering of the water level has been carried on until very recent time, and is probably still in progress is shown by the writer's observations and by those of Camsell.² The latter, in describing a muskeg area near Moose Lake, wrote, "Judging by the shells on the muskeg, the whole must have been covered with water at no very remote period;" and again, referring to Bog, or Thul-tue,

¹ For a discussion of these post-glacial lakes and their relations to the distribution of the vegetation see: Cameron, A. E. *Post-Glacial Lakes in the Mackenzie River Basin, Northwest Territories, Canada*. Journ. of Geol. xxx. 337 (1922). Raup, Hugh M. *The Distribution and Affinities of the Vegetation of the Athabasca-Great Slave Lake Region*. RHODORA, xxxii. (1930).

² Camsell, Charles. *The Region Southwest of Fort Smith, Slave River, N. W. T.* Geol. Surv. Can., Ann. Rept. xv. 156A and 163A (1903).

Lake, "At one time the lake probably extended over all the river valley as far down as the last mentioned rapids, for the whole of this part lies in a well defined valley and is still very wet and marshy and covered with swamp grass and willows The deepening of the channel at these rapids, however, caused the water to drain off, lowering the lake to its present level and shore line." On the western slopes of the Nini-sheth Hills, a part of the moraine lying northeast of Moose Lake, there are faint indications of abandoned sandy beaches which marked the shore of the ancient lake. An old portage trail from the Little Buffalo River to Moose Lake does not reach the lake shore by several hundred yards, approaching nearest it at the bottom of a deep bay which is now nearly filled with a wet slough vegetation. This was a summer trail, and from its appearance has been long in disuse. The cuttings are very old ones and there are long discarded remains of birch bark canoes about the lake shore. It is probable that the trail has not been used in summer for many years, and that since its use the lake has experienced a permanent fall of one or two feet in water level, with the growth of a wide marsh between the present shore and the old landings. If the present condition had existed when the trail was formerly used, the Indians would undoubtedly have made their landing on a point at the north of the embayment, which it is now necessary to do.

Such a drop in the level of the lake, occurring on the shores previously described, would expose for the acquisition of a new plant cover the peaty accumulations in the *Scirpus* and *Typha* associations. Occurring as ridges, these would have fairly good drainage and would soon develop the semi-mesophytic vegetation of *Salix* and *Calamagrostis* with their secondary associates, or, in muskeg surroundings, a combination of these with *Picea mariana* and *Larix*. The present open, shallow water associations between the ridges would become *Carex diandra* zones, involving in some situations *C. aquatilis*, *C. rostrata*, and *Equisetum limosum*.

Causes for the formation of the peat ridges, therefore, appear to be in the selection of certain definite zones of the shore habitat by *Scirpus validus*, *Typha latifolia*, and their associates, with the consequent differential accumulation of vegetable remains, and in the recent lowering of the level of the lake to expose the ridges thus formed.

Lewis, Dowding, and Moss have described with considerable detail the arrangement of *Larix* and *Betula glandulosa* on ridges which occur

at muskeg margins in central Alberta.¹ They suggest that these ridges may have been formed partly by the lowering of the water level in the bog, and partly by the greater accumulation of peat on the ridges due to a richer growth of vegetation. It may be that the initial stage of this condition was similar to that now existing in the more recently developing muskegs of the Moose Lake basin.

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SCIRPUS PUMILUS IN THE ROCKY MOUNTAINS.—One of the most localized sedges of North America is the little species, *Scirpus pumilus* Vahl (1806) or *S. alpinus* Schleicher (1828), which was recently found on the Mingan Islands and Anticosti by Victorin and Rolland. In a most interesting discussion of its occurrence there Bro. Victorin² cites in America, besides the stations on the Gulf of St. Lawrence, only an old specimen of *Hall & Harbour* from an unidentified locality in the Rocky Mountains. In examining the sheets in the Gray Herbarium in the covers of *Eleocharis pauciflora* (Lightf.) Link or *Scirpus pauciflorus* Lightf. I find two collections of characteristic *S. pumilus* from comparatively low altitudes in the Canadian Rocky Mountains. One, distributed as *S. pauciflorus*, is in splendid condition and the essential data on the label are: marsh, Devil's Lake, Banff, Alberta, alt. 4600 ft., July 5, 1907, *Butters & Holway*, no. 50; the other, an over-ripe series, came from the herbarium of the late C. F. Wheeler and had been correctly identified by him: from Laggan, British Columbia, August 23, 1902, alt. 5000 ft., no. 1057 (collector not stated). Still another Rocky Mountain station, not cited in the recent discussion of the plant, was recorded in 1892 by Dr. Britton. Besides the Hall & Harbour collection Britton cited one from "Morley, British Columbia, Rocky Mountains (Macoun, 44)."³ The Banff and Laggan stations, supplementing that at Morley, suggest that search in herbaria may show that *Scirpus pumilus* has an extensive range in

¹ Lewis, F. J., Dowding, E. S., and Moss, E. H. *The Vegetation of Alberta II. The Swamp, Moor, and Bog Forest Vegetation of Central Alberta.* Journ. of Ecol. xvi. 31-35, Pls. iii. and iv., Fig. 2 (1928).

² Victorin, *Additions aux Cypéracées de l'Amérique du Nord.* Trans. Roy. Soc. Can. ser. 3, xxiii. pt. 2, sect. V. 253—reprinted as Contrib. Lab. Bot. Univ. Montr. No. 15: 253 (1929).

³ Britton, Trans. N. Y. Acad. Sci. xi. 75—reprinted as Contrib. Herb. Columbia Coll. no. 26: 2 (1892). This record presumably was the basis of the inclusion of the species in Rydberg, Fl. Rocky Mts. 109 (1917).